REMARKS

Claims 1-6, 8-11 and 13 are rejected, and claims 12, 14 and 15 are withdrawn from consideration as being directed to a non-elected invention. Review and reconsideration on the merits are requested.

Claims 1-6, 8-11 and 13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over WO 2003/065465 to Udagawa, with reference to U.S. Patent No. 7,465,499 as an English language equivalent. In addition to disclosing the basic structure of the claimed device, the Examiner considered that the diffusion of phosphorous atoms into the light-emitting layer 104 would result in the claimed profile. Further, the prior art is said to recognize the importance of smoothing the transition at heterojunctions to avoid lattice mismatch, and that managing phosphorous content is said to be one way of doing this. Based thereon, the Examiner concluded that phosphorous concentration is an art-recognized result-effective variable, such that it would have been obvious to optimize, by routine experimentation, the phosphorous content to smooth the lattice transition at the heterojunctions around the light-emitting layer.

1. Diffusion of Phosphorous Atoms into the Light-Emitting Layer 104 of U.S. Patent No. 7,465,499 to Udagawa Does Not Result in the Claimed Profile

In response, the present Applicant (Dr. Udagawa) respectfully disagrees that diffusion of phosphorous atoms into the light-emitting layer 104 of WO '465 (also by the same Dr. Udagawa) will result in the recited profile (i.e., a profile of phosphorous atom concentration that gradually decreases from a bottom thereof in a thickness direction). This is explained as follows.

In U.S. Patent No. 7,465,499 to Udagawa, layer 103 shown in Fig. 5 is p-type boron phosphide (BP) layer, and the layer 105 is an n-type boron phosphide (BP) layer (col. 11, lines 34-35).

Although there is a difference of conduction type among the BP layer 103 and the BP layer 104, the BP layer 103 and the BP layer 104 are formed from the same material, which is boron phosphide. Further, the p-type BP layer 103 is stacked on the surface of the buffer layer 102 at 1,050°C (col. 10, lines 31-33) and the BP layer 104 that is the light-emitting layer is stacked on the surface of the layer 103 at 850°C (col. 11, lines 3-5) and then the n-type BP layer 105 is stacked on the surface of the BP layer 104 at 1,050°C (col. 11, lines 10-12).

Because the light-emitting layer 104 is stacked at 850℃ which is a relatively low temperature, one expects that either phosphorus hardly diffuses into the light-emitting layer 104 from the BP layer 103, or the quantity of diffusion of phosphorus into the light-emitting layer 104 is slight.

Further, because both the p-type BP layer 103 and the n-type BP layer 105 are formed from the same material, phosphorus diffuses into the light-emitting layer 104 from both the p-type BP layer 103 and the n-type BP layer 105 while forming the n-type BP layer 105 at 1,050℃. Therefore, in the case of Udagawa (U.S. Patent No. 7,465,499), a profile of phosphorus atoms concentration of the light-emitting layer 104 becomes the highest at a portion of the junction interface between the light-emitting layer 104 and the p-type BP layer 103 or the n-type BP layer 105. On the other hand, the profile of phosphorus atoms concentration becomes the lowest at the middle portion of the light-emitting layer 104.

Accordingly, in the case of Udagawa (U.S. Patent No. 7,465,499), the diffusion of phosphorus atoms into the light emitting layer 104 forms a profile different from the profile required by present claim 1 (i.e., wherein the light-emitting layer has a profile of phosphorous atom concentration that gradually decreases from a bottom thereof in a thickness direction).

2. Phosphorous Atom Concentration in the Light-Emitting Layer is Not Subject to Routine Optimization

As noted above, the Examiner considered that phosphorous atom concentration in the light-emitting layer is subject to routine optimization so as to smooth the transition at heterojunctions and avoid lattice mismatch. However, the Examiner has not cited any documents which show that the prior art recognizes that imparting a phosphorous atom concentration gradient to the light-emitting layer can smooth the transition at the lower and upper heterojunctions so as to alleviate lattice mismatch. Not only does U.S. Patent No. 7,465,499 to Udagawa fail to disclose or suggest such feature (phosphorous atom concentration gradient of the light-emitting layer), the Examiner has not cited any documents which show the subject feature. Also, even if the prior art does suggest adjusting the phosphorous content in the light-emitting layer to a specific value so as to reduce lattice mismatch, that does not mean that the prior art suggests establishing a gradient in phosphorous atom concentration, let alone a gradient where the phosphorous atom concentration is highest at the bottom of the light-emitting layer and gradually decreases in the thickness direction towards the top of the light-emitting layer as claimed in claim 1.

3. One of Ordinary Skill in the Art Would Optimize the Composition of Those Layers Which are in Contact with the Light-Emitting Layer to Avoid Lattice Mismatch, but Would Not Modify Let Alone Optimize the Composition of the Light-Emitting Layer

As noted above, the Examiner considered that phosphorous atom concentration in the light-emitting layer is subject to routine optimization so as to smooth the transition at heterojunctions to avoid lattice mismatch. Applicant respectfully disagrees and explains as follows.

Instead of the composition of the light-emitting layer, the compositions of the layers in contact with the light-emitting layer are adjusted or optimized. If the composition of the light-emitting layer is changed, the band gap of the light-emitting layer will also be changed and the light-emitting layer will not transmit light of the intended wavelength.

Further, if the light-emitting layer is modified to have a composition gradient, as required by present claim 1, an emission spectrum of emitted light from the light-emitting layer will broaden. Therefore, usually, those persons skilled in the art related to the invention avoid and do not try to form a composition gradient in the light-emitting layer.

Accordingly, phosphorous atom concentration of the light-emitting layer is not subject to routine optimization.

For the above reasons, it is respectfully submitted that the present claims are patentable over WO 2003/065465 to Udagawa, and withdrawal of the foregoing rejection under 35 U.S.C. § 103(a) is respectfully requested.

Claims 1-6, 8-11 and 13 were rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over the claims of US '499.

Applicant relies on the response above with respect to the rejection of the present claims over corresponding WO '465 under 35 U.S.C. § 103(a). US '499, including its claims, does not teach or inherently disclose that diffusion of phosphorous atoms into the light-emitting layer 104 of US '499 will result in the recited profile. Further, US '499 does not show that the prior art recognizes that imparting a phosphorous atom concentration gradient to the light-emitting layer can smooth the transition at the lower and upper heterojunctions. Yet further, those skilled in this field of art would optimize or adjust the composition of the layers in contact with the light-emitting layer, but not that of the light-emitting layer itself. This is because if the composition of

the light-emitting layer is changed, the bandgap will change and the light-emitting layer will not transmit light of the intended wavelength. None of this is disclosed or suggested by US '499 including the claims of US '499, and withdrawal of the foregoing obviousness-type double patenting rejection is respectfully requested.

Withdrawal of all rejections and allowance of claims 1-6, 8-11 and 13 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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